IV. Remarks.

The Examiner entered the following rejections.

1. Claims 1, 4, 6, 13, 16, 28, 31 and 43-45 are rejected under 35 USC 102(b) as being anticipated by Winninger et al (US 6,033,331).

As to claims 1, 13, 28, 43 and 45 in the office action the Examiner notes that the abbreviated copy of the ISO standard provided by Applicant in the prior response did not include the referenced characters of standard dimensions designated H, J, K, L and M by Winninger et al, nor did Winninger disclose a date of issue or numbered edition of the ISO standard.[1] Consequently, the Examiner concluded that a written disclosure of "a definitive angle with respect to the disclosure of Winninger et al, *other than as depicted*, is not realized".[2] Absent this information, in order to support the 102(b) rejection the Examiner appears to rely solely on Winninger Fig. 1 as depicted to teach the limitation directed to "the ribbed profile having a rib with an angle of approximately 90°".[3]

Regarding the sufficiency of prior art references in support of a 102(b) rejection, the court in *Amgen, Inc. v. Hoechst Marion Roussel, Inc.*, 314 F.3d 1313 (Fed.Cir.2003) stated that:

> "In patent prosecution the examiner is entitled to reject application claims as anticipated by a prior art patent without conducting an inquiry into whether or not that patent is enabled or whether or not it is the claimed material (as opposed to the unclaimed disclosures) in that patent that are at issue. *In re Sasse*, 629 F.2d 675, 681, 207 USPQ 107, 111 (C.C.P.A.1980) ("[W]hen the PTO cited a disclosure which expressly anticipated the present invention ... the burden was shifted to the applicant. He had to rebut the presumption of the operability of [the prior art patent] by a preponderance of the evidence."(citation omitted)). *The applicant, however, can then overcome that rejection by proving that the relevant disclosures of the prior art patent are not enabled.*" (emphasis added).

In particular, the court in *Sasse* observed:

> "...the proper test of a description in a publication as a bar to a patent as the clause is used in section 102(b) requires a determination of whether one skilled in the art to which the invention pertains could take the description of the invention in the printed publication and combine it with his own knowledge of the particular art and from this combination be put in possession of the invention on which a patent is sought. *Unless this condition prevails, the description in the printed publication is*

[1] The ISO standards actually refer to profiles PH, PJ, PK, PL and PM while Winninger specifies profiles "H, J, K, L and M" (3:36), which Applicant is willing to presume refers to the ISO standards for the sake of this argument.

[2] This alone may be fatal to Winninger as a 102(b) reference since it suggests that Winninger on its face does not enable the claimed rib angle.

[3] Applicant notes that Winninger was originally presented as a secondary reference for a 35 USC 103(a) rejection presented in a prior office action mailed 02/23/2007.

inadequate as a statutory bar to patentability under section 102(b)." (emphasis added).[4]

In the instant case the law does not support the Examiner's reliance on Fig. 1 to teach the missing rib angle information. Fig. 1 simply does not teach any rib angle. Fig. 1 cannot be scaled.

As to the written disclosure, the inventor Winninger was careful to specify various particular belt dimensions, including "P" (pitch at 3:34), "L" (belt width at 3:48), "d" (twisted strand width 5:12 and Fig. 1) and "e" (distance between strands 5:12 and Fig. 1)[5]. Given the choice Winninger did not specify any angles in the specification, and instead specifically chose to rely on an extrinsic source to provide other apparently less relevant information such as angles, namely, see US 6,033,331 referring to ISO 9981 at 3:36-37.

Attached to this paper is the full copy of ISO 9981. Table 1 on page 3 discloses the only relevant angle as noted in Applicant's earlier filed arguments, i.e., groove angle 40°.[6]

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[4] It is illustrative to touch on the prosecution requirements relating to 35 USC 112. It is well established that absent full, clear and exact disclosure in the specification, the examiner cannot rely on the drawings alone to supply missing information, and in particular incomplete drawings. The court in *In Re Olson*, 41 CCPA 871, 212 F.2d 590 (1954) stated:

> "Ordinarily drawings which accompany an application for a patent are merely illustrative of the principles embodied in the alleged invention claimed therein and do not define the precise proportions of elements relied upon to endow the claims with patentability. In re Kinderman, 178 F.2d 937, 37 C.C.P.A., Patents, 800. See also In re Betz, 166 F.2d 831, 35 C.C.P.A., Patents, 1033; Wasberg v. Ditchfield, 155 F.2d 408, 33 C.C.P.A., Patents, 1099. Accordingly, the board in refusing to accept appellant's affidavit and the proposed amendments of his specification properly held:
>
> 'The statement as to the particular spatial relationship between the parts included in these claims, which is objected to by the Examiner, is not clearly shown in the drawing and there is nothing in the drawing which definitely supports appellant's contention. *It is well known that Patent Office drawings are not normally drawn to scale, with the dimensions and sizes of parts shown to exact measurements as are shop drawings.* In the particular case under consideration, the distances and dimensions involved are of the order of a few thousandths of an inch and *it appears obvious that the drawing alone cannot be scaled off*, under these circumstances, *to show that any particular distances or sizes are exactly equal when the specification is completely silent in this respect.* For this reason, we do not consider that appellant's drawing supports the position he has taken in respect thereto and we will affirm the Examiner's rejection of these claims as drawn to new matter.'" (emphasis added).

Olson concerned the propriety of using only the drawings to attempt to establish that ball centering means were equally spaced from the valve seats, given this limitation was not disclosed at all in the original specification. In fact, the drawings were incomplete so that even in the face of material which the court believed was patentable, the *Olson* court upheld the Board's rejection of all claims for lack of disclosure.

[5] In fact, "P" and "L" relate to the "teeth 23" (ribs). Applicant addressed the meaning of "ribs" and "teeth" in a prior paper.

[6] Again, this source is at best somewhat ambiguous since ISO 9981 refers to a "groove" angle in Table 1. Applicant is willing to accept that pulley groove angle can equal belt rib angle solely for the purposes of this

As to the relevant date of ISO 9981, page ii states:

> "This second edition cancels and replaces the first edition (ISO 9981:1990), which has been technically revised. In particular, a subclause on the tolerances on the diameters over balls (3.3.4) has been added."

Hence, the ISO standard in effect at the time Winninger was filed (Sep. 19, 1997) was ISO 9981:1990. The only change from the 1990 version to the 1998 version was made to section 3.3.4 which does not alter the disclosed angle in Table 1. Hence ISO 9981 only discloses a groove (rib) angle of 40°.

Page 1, section "1 Scope" of ISO 9981 states that:

> "The complete array of V-ribbed belts and pulleys of PH, PJ, PK, PL and PM profile for industrial and other non-automotive applications is the subject of ISO 9982. PK belt profile dimensions and tolerances are the same in both International Standards."

As to ISO 9982:1998, the standard in effect in 1997 was ISO 9982:1991. Page ii states:

> "This second edition cancels and replaces the first edition (ISO 9982:1991), which has been technically revised. In particular, one subclause on the diameters over balls and another on the manufacturing tolerances for effective lengths of V-ribbed belts have been added."

Hence, the ISO 9982 standard in effect at the time Winninger was filed was ISO 9982:1991. The only changes between the first edition 1991 and second edition 1998 are noted above, which do not include changes to groove (rib) angles.

As so, as to groove (rib) angles for profiles PH, PJ, PK, PL and PM profiles the pulley groove angle is listed as 40°, see Table 1, page 3. Each rib on a ribbed belt engages a pulley groove, and so presumably has a like angle for the sake of this argument, see 1 Scope on page 1, ISO 9982. Both ISO standards specify a groove angle of 40° which Applicant asserts for the purpose of argument may correspond to a belt rib angle of 40°. No other angles are disclosed. The tolerance range for the groove angle in Table 1 for both ISO standards is ±0.5°.

Consequently, at best Winninger enables a groove (rib) angle in the range of 39.5° to 40.5°. Winninger fails to anticipate the noted claims because it does not enable use of the claimed rib angle of approximately 90°.

The remaining claims are dependent. Applicant requests that the application be passed to allowance.

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argument. Nonetheless, ISO 9981 does not refer to belt "rib" angles at all, which further casts doubt on the capacity of the ISO standards to enable the claimed rib angle limitation of 90°.

2. Claims 2 and 5, 14, 17 and 29 are rejected under 35 USC 103(a) as being unpatentable over Winninger et al in view of Adifon et al (WO 99/43598).

Each of the noted claims are dependent.

3. Claims 3, 15, 18, 21-22 and 30 are rejected under 35 USC 103(a) as being unpatentable over Winninger et al in view of Adifon, as applied to claims 2, 14 and 29, and in further view of Suhling (DE 3,934,654) and Siefert (US 3,662,596).

Each of the noted claims are dependent.

4. Claim 19 is rejected under 35 USC 103(a) as being unpatentable over Winninger et al in view of Adifon et al in view of Suhling and Seifert, as applied to claim 15, and in further view of White, Jr. et al.

The noted claim is dependent.

5. Claim 20 is rejected under 35 USC 103(a) as being unpatentable over Winninger et al in view of Adifon et al, Suhling and Seifert and White, Jr. et al as applied to claim 19, and in further view of Stork (US 3,948,113).

The noted claim is dependent.

6. Claim 7 is rejected under 35 USC 103(a) as being unpatentable over Winninger et al in view of Adifon et al, as applied to claim 2 and in further view of White Jr. et al.

The noted claim is dependent.

7. Claims 8-10 are rejected under 35 USC 103(a) as being unpatentable over Winninger et al in view of Adifon et al and White Jr et al, as applied to claim 7, and in further view of Stork.

Each of the noted claims are dependent.

8. Claims 11 and 23 are rejected under 35 USC 103(a) as being unpatentable over of Winninger et al in view of Siefert.

Each of the noted claims are dependent.

9. Claims 12 and 24 are rejected under 35 USC 103(a) as being unpatentable over Winninger et al, in view of Suhling.

Each of the noted claims are dependent.

10. Claims 25, 33-34 and 36-37 are rejected under 35 USC 103(a) as being unpatentable over Winninger et al in view of Stork.

Each of the noted claims are dependent.

11. Claim 26 is rejected under 35 USC 103(a) as being unpatentable over Winninger et al in view of Suhling and further view of Stork.

The noted claim is dependent.

12. Claims 35 and 38 are rejected under 35 USC 103(a) as being unpatentable over Winninger et al, Suhling and Seifert, as applied to claim 26, and in further view of Stork.

Each of the noted claims are dependent.

13. Claims 1-2, 4-5, 13-14, 16, 17, 28-29, 31 and 43-45 are rejected under 35 USC 103(a) as being unpatentable over Adifon et al (WO 99/43598) in view of McKay (US 2,221,984).

A rejection based on 35 U.S.C. § 103 must rest on a factual basis, with the facts being interpreted without a hindsight reconstruction of the invention from the prior art. Thus, in the context of an analysis under § 103, it is not sufficient merely to identify one reference that teaches several of the limitations of a claim and another that teaches several limitations of a claim to support a rejection based on obviousness. This is because obviousness is not established by combining the basic disclosures of the prior art to produce the claimed invention absent a teaching or suggestion that the combination be made. Interconnect Planning Corp. v. Fiel, 774 F.2d 1132, 1143, 227 U.S.P.Q. (BNA) 543, 551 (Fed.Cir. 1985); In Re Corkhill, 771 F.2d 1496, 1501-02, 226 U.S.P.Q. (BNA) 1005, 1009-10 (Fed.Cir. 1985). The relevant analysis invokes a cornerstone principle of patent law:

> That all elements of an invention may have been old (the normal situation), or some old and some new, or all new, is . . . simply irrelevant. Virtually all inventions are combinations and virtually all are combinations of old elements. Environmental Designs v. Union Oil Co. of Cal., 713 F.2d 693, 698 (Fed.Cir. 1983) (other citations omitted).
>
> ***
>
> A patentable invention . . . may result even if the inventor has, in effect, merely combined features, old in the art, for their known purpose without producing anything beyond the results inherent in their use. American Hoist & Derek Co. v. Sowa & Sons, Inc., 220 U.S.P.Q.

(BNA) 763, 771 (Fed.Cir. 1984) (emphasis in original, other citations omitted).

As the Court of Appeals for the Federal Circuit recently noted, "[w]hen a rejection depends upon a combination of prior art references, there must be some teaching, suggestion, or motivation to combine the references." Ecolochem, Inc. v. Southern Calif. Edison, 56 U.S.P.Q. 2d 1065, 1073 (Fed.Cir. 2000). There must be a rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references. In re Dembiczak, 175 F.3d 994, 999 (Fed.Cir. 1999). This is because "combining prior art references without evidence of such a suggestion, teaching, or motivation simply takes the inventor's disclosure as a blueprint for piecing together the prior art to defeat patentability." Id. Accordingly, to establish a rejection under 35 U.S.C. § 103, a person of ordinary skill in the art must not only have had some motivation to combine the prior art teachings, but also some motivation to combine the prior art teachings in the particular manner claimed. See, e.g., In re Kotzab, 217 F.3d 1365, 1371 (Fed.Cir. 2000). In other words, the Examiner must show reasons that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed. In re Rouffet, 149 F.3d 1350, 1357 (Fed.Cir. 1998).

The references do not teach all of the claim limitations and hence there is no incentive to combine the references. In particular, as to independent claims 1, 13, 28, 43 and 45 it is easily established that Adifon makes no mention of ribs, instead only teaching *flat* ropes (16), see WO '598 page 4, line 20. The disclosed flat ropes do not comprise nor teach nor reasonably suggest ribs. Ribs are simply not present nor implied. Adifon fails as a primary reference.

McKay does not teach nor reasonably imply the claimed rib angle. Although McKay cites "ribs 12", the specific disclosure cited by the Examiner (Pg. 2, lines 35-49) simply does not specify a rib angle, but instead only refers generally to "pyramidal recesses" or "depressions", at line 41. The term "pyramidal" in no way teaches a rib angle range of approximately 90° since a pyramid may have very "steep" sides, as in an obelisk, or be very "flat" having extremely divergent sides such as with a very wide base and minimal height. As argued for the rejection in rejection no. 1 above, the figures in McKay cannot be "scaled" to reach the desired rib angle, nor do any of the figures otherwise specify a rib angle.[7] Lastly, and unlike Winninger, McKay does not incorporate any other source to provide any "rib" angle information at all. Consequently, the combination does not enable the limitation

[7] McKay also fails as a 102(b) reference for the reasons argued in rejection no. 1 above, namely, McKay does not enable the claimed invention because the specification does not disclose a rib angle, and it is not appropriate to scale the McKay figures.

directed to "the ribbed profile having a rib with an angle of approximately 90°".

The remaining claims are dependent. Applicant requests that the application be passed to allowance.

V. Fees

Any fees payable for this response may be deducted from deposit account 07-0475 in the name of The Gates Corporation.

Thank you for your attention to this case.

Sincerely,

Date: Oct. 19, 2007

Jeffrey Thurnau
Attorney for Applicant
Reg. No. 42,183
303-744-4743

INTERNATIONAL STANDARD

ISO 9982

Second edition
1998-08-15

Belt drives — Pulleys and V-ribbed belts for industrial applications — PH, PJ, PK, PL and PM profiles: Dimensions

Transmissions par courroies — Poulies et courroies striées pour des applications industrielles — Profils PH, PJ, PK, PL et PM: Dimensions

Reference number
ISO 9982:1998(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9982 was prepared by Technical Committee ISO/TC 41, *Pulleys and belts (including veebelts)*, Subcommittee SC 1, *Veebelts and grooved pulleys*.

This second edition cancels and replaces the first edition (ISO 9982:1991), which has been technically revised. In particular, one subclause on the diameters over belts and another on the manufacturing tolerances for effective lengths of V-ribbed belts have been added.

Annex A of this International Standard is for information only.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch
Printed in Switzerland

Introduction

A V-ribbed belt drive is composed of an endless belt with a longitudinally ribbed traction surface which engages and grips, by friction, pulley grooves of similar shape. The belt ribbed surface fits the pulley grooves to make nearly total contact.

Belt drives — Pulleys and V-ribbed belts for industrial applications — PH, PJ, PK, PL and PM profiles: Dimensions

1 Scope

This International Standard specifies the principal dimensional characteristics of V-ribbed pulley groove profiles, together with the corresponding endless V-ribbed belts, of PH, PJ, PK, PL and PM profiles which are used for general industrial applications.

The PK belt was originally established for automotive accessory drive applications and ISO 9981 deals specifically with that particular field.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of the publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 254:1998, *Belts drives — Pulleys — Quality, finish and balance.*

ISO 4287:1997, *Geometrical product specification (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters.*

3 Pulleys

3.1 Groove dimensions and tolerances

The groove dimensions of PH, PJ, PK, PL and PM belts are shown in figures 1 and 2, and given in table 1.

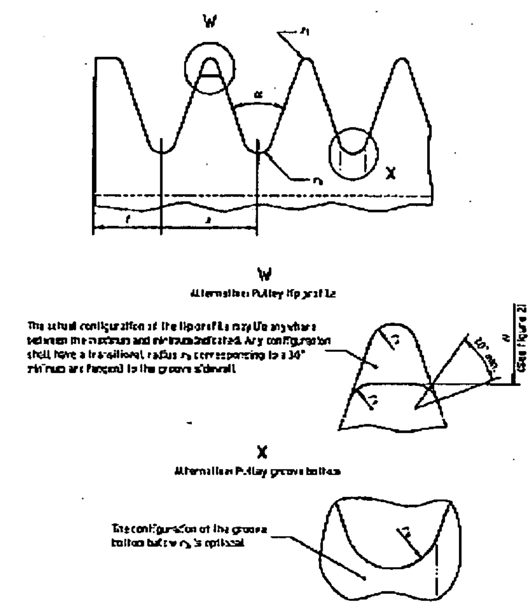
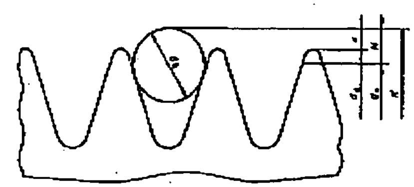


Figure 1 — Cross-section of pulley grooves



d_e = effective diameter
d_o = outer diameter
K = diameter over balls or rods
d_B = checking ball or rod diameter

Figure 2 — Pulley diameters

Table 1 — Dimensions of pulley grooves

Dimensions in millimetres

Profile		PH	PJ	PK	PL	PM
Groove pitch, e [1) 2)]		1,6 ± 0,03	2,34 ± 0,03	3,56 ± 0,05	4,7 ± 0,05	9,4 ± 0,08
Groove angle, α [3)]	± 0,5°	40°	40°	40°	40°	40°
r_1	min.	0,15	0,2	0,25	0,4	0,75
r_b	max.	0,3	0,4	0,5	0,4	0,75
Checking ball or rod diameter, d_B	± 0,01	1	1,5	2,5	3,5	7
$2x$	nom.	0,11	0,23	0,99	2,36	4,53
$2N$ [4)]	max.	0,69	0,81	1,68	3,5	5,92
f	min.	1,3	1,8	2,5	3,3	6,4

1) The tolerance on e applies to the distance between the axes of two consecutive grooves.

2) The sum of all deviations from the nominal value e for all grooves in any pulley shall not exceed ± 0,3.

3) The centreline of the groove shall make an angle of 90° ± 0,5° with the axis of the pulley.

4) N is not related to the nominal diameter of the pulley but is measured from the actual axial position of the ball or rod in the pulley.

3.2 Minimum effective diameter

The minimum recommended effective diameter, d_e, for V-ribbed pulleys is given in table 2.

Table 2 — Minimum effective diameter

Dimensions in millimetres

Profile		PH	PJ	PK	PL	PM
Effective diameter, d_e	min.	13	20	45	75	180

3.3 Tolerances on finished pulley

3.3.1 Checking conditions

Profile, diameter and run-out tolerances shall be checked on the finished pulley without surface coating.

3.3.2 Groove-to-groove diameter tolerances

The variation in diameters between the grooves in any one pulley shall be within the limits given in table 3. This variation is obtained by comparing the diameter over balls or rods.

Table 3 — Groove-to-groove diameter variation

Dimensions in millimetres

Effective diameter, d_e	Number of grooves, n	Maximum diameter variation
$d_e \leq 74$	$n \leq 6$	0,1
	$n > 6$	Add 0,003 for each additional groove
$74 < d_e \leq 500$	$n \leq 10$	0,15
	$n > 10$	Add 0,005 for each additional groove
$d_e > 500$	$n \leq 10$	0,25
	$n > 10$	Add 0,01 for each additional groove

3.3.3 Radial circular run-out

Radial circular run-out shall be within the limits given in table 4. Radial run-out measured with a ball mounted under spring pressure to ensure contact with the groove as the pulley is rotated.

Table 4 — Radial run-out

Dimensions in millimetres

Effective diameter, d_e	FIM [1)] max.
$d_e \leq 74$	0,13
$74 < d_e \leq 250$	0,25
$d_e > 250$	0,25 + 0,000 4 per millimetre of effective diameter over 250

1) Full indicator movement.

3.3.4 Axial circular run-out

Axial circular run-out (full indicator movement) shall be within 0,002 mm per millimetre of effective diameter. Run-out is measured with a ball mounted under spring pressure to ensure contact with the groove as the pulley is rotated.

3.3.5 Diameter over balls

The tolerances on the diameter over balls (K) shall be within the limits given in table 5.

Table 5 — Tolerance on the diameter over balls

Dimensions in millimetres

Diameter over balls, K	Tolerance
$K \leq 75$	±0,3
$75 < K \leq 200$	±0,6
For each additional 25 mm, add	±0,1

3.3.6 Groove finish

The pulley grooves shall have a surface roughness $R_a \leq 3{,}2$ µm. See ISO 254 and ISO 4287 for definitions and the method of measurement.

3.4 Pitch diameter, d_p

The fit of a V-ribbed belt in the corresponding pulley is shown in figure 3. The true pitch diameter of a V-ribbed pulley is slightly larger than the effective diameter and its exact value is determined with the particular belt being used.

The appropriate nominal value of the effective line differential b_e, which is:

0,8 mm for the PH profile,

1,2 mm for the PJ profile,

2 mm for the PK profile,

3 mm for the PL profile, and

4 mm for the PM profile;

may be used to calculate the speed ratio. If more precision is required, the belt manufacturer should be consulted.

Further information is given in ISO 9370.

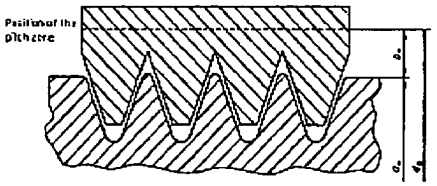


Figure 3 — Determination of pitch diameter

3.5 Designation of pulleys

A V-ribbed pulley is characterized by the number of grooves, the profile and the effective diameter. It is designated by a series of numbers and letters as follows:

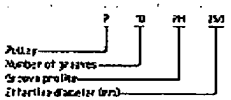
a) the first letter "P" means "Pulley";

b) the first set of numbers indicates the number of grooves;

c) the second set of letters indicates the groove profile;

d) the second set of numbers indicates the effective diameter, in millimetres.

EXAMPLE



4 Belts

4.1 Belt dimensions

The belt dimensions are shown on figure 4, and given in table 6.

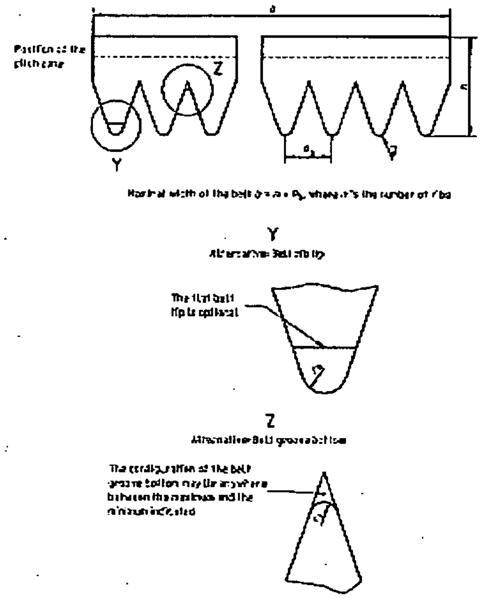


Figure 4 — Cross-section of belt

Table 6 — Belt dimensions

Dimensions in millimetres

Profile		PH	PJ	PK	PL	PM
Rib pitch, p_b		1,8	2,34	3,56	4,7	9,4
r_b	min.	0,3	0,4	0,5	0,4	0,75
r_t	max.	0,15	0,2	0,25	0,4	0,75
Belt height, h	≈	3	4	6	10	17

NOTE — Belt rib pitch and belt height are shown as reference dimensions only. Cumulative rib pitch tolerance is an important value, however, it is frequently affected by the tension at which the belt operates and the modulus of the tension member.

4.2 Measurement of effective belt length

4.2.1 Measuring fixture (see figure 5)

The effective belt length shall be determined by placing the belt on a measuring fixture composed of the following elements.

4.2.1.1 Two pulleys of equal diameter, one of which is fixed and the other movable.

Their profile shall comply with figure 1 and table 1, and their recommended effective diameter shall be determined from the values given in table 7.

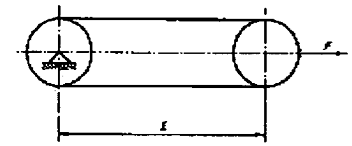


Figure 5 — Measuring fixture to determine effective length

Table 7 — Measuring pulleys and measuring forces

Dimensions in millimetres and measuring forces in newtons

Profile	PH		PJ		PK	PL	PM
Pulley effective circumference (at the level of effective diameter), U_e	100	300	100	300	300	500	800
Diameter over balls or rods, K ±0,13	31,94	95,6	32,06	95,72	95,48	164,91	259,17
Measuring force per rib, F	30		50		100	200	450

4.2.1.2 Device for applying a total measuring face to the movable pulley.

4.2.1.3 Device for measuring the centre distance between the two pulleys.

4.2.2 Measuring force

The measuring force to be applied for measuring the effective length of belts is given in table 7.

4.2.3 Procedure

To measure the effective length of a belt, rotate the belt at least two revolutions to seat it properly and to divide the total force equally between the two strands of the belt.

Then measure the centre distance between the pulleys, E, and calculate the effective length, L_e, of the belt using the following formula:

$$L_e = E_{max} + E_{min} + U_e$$

where

U_e is the effective circumference of the measuring pulleys;

E_{max} is the maximum centre distance between the pulleys;

E_{min} is the minimum centre distance between the pulleys.

4.2.4 Manufacturing tolerances

The permissible manufacturing tolerances for effective lengths of V-ribbed belts are given in table 8.

The tolerances for table 8 are approximately calculated using the equations given below. The values for L_e in the equation are the maximum for the range and the results are rounded to reasonable values.

$$+0{,}3\sqrt[3]{L_e} + 0{,}003\,L_e$$

$$-2 \times \left(0{,}3\sqrt[3]{L_e} + 0{,}003\,L_e\right)$$

Table 8 — Manufacturing tolerances for effective lengths of V-ribbed belts

Dimensions and tolerances in millimetres

Effective length	Permissible deviation for profiles				
L_e	PH	PJ	PK	PL	PM
$200 < L_e \leqslant 500$	+4 −8	+4 −8	+4 −8		
$500 < L_e \leqslant 750$	+5 −10	+5 −10	+5 −10		
$750 < L_e \leqslant 1\,000$	+6 −12	+6 −12	+6 −12	+6 −12	
$1\,000 < L_e \leqslant 1\,500$	+8 −16	+8 −16	+8 −16	+8 −16	
$1\,500 < L_e \leqslant 2\,000$	+10 −20	+10 −20	+10 −20	+10 −20	
$2\,000 < L_e \leqslant 3\,000$	+12 −24	+12 −24	+12 −24	+12 −24	+12 −24
$3\,000 < L_e \leqslant 4\,000$				+15 −30	+15 −30
$4\,000 < L_e \leqslant 6\,000$				+20 −40	+20 −40
$6\,000 < L_e \leqslant 8\,000$				+30 −60	+30 −60
$8\,000 < L_e \leqslant 12\,500$					+45 −90
$12\,500 < L_e \leqslant 17\,000$					+60 −120

4.3 Designation of belts

A V-ribbed belt is characterized by the number of belt ribs, the profile and the effective length. It is designated by a series of numbers and letters as follows:

a) the first set of numbers indicates the number of belt ribs;

b) the letters indicate the belt profile;

c) the second set of numbers indicates the effective length, in millimetres.

EXAMPLE

1) PM 3 550

Number of belt ribs — 1)
Belt profile — PM
Effective length (mm) — 3 550

Annex A
(informative)

Bibliography

[1] ISO 8370-2:1993, *Belt drives — Dynamic test to determine pitch zone location — Part 2: V-ribbed belts.*

[2] ISO 9981:1998, *Belt drives — Pulleys and V-ribbed belts for the automotive industry — PK profile: Dimensions.*

ICS 21.220.10

Descriptors: belt drives, pulleys, grooved pulleys, power transmission belts, V-belts, form specifications, dimensions, designation

Price based on 11 pages

INTERNATIONAL STANDARD

ISO 9981

Second edition
1998-11-01

Belt drives — Pulleys and V-ribbed belts for the automotive industry — PK profile: Dimensions

Transmissions par courroies — Poulies et courroies stries pour la construction automobile — Profil PK Dimensions

Reference number
ISO 9981:1998(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9981 was prepared by Technical Committee ISO/TC 41, *Pulleys and belts (including vee-belts)*, Subcommittee SC 1, *Vee-belts and grooved pulleys*.

This second edition cancels and replaces the first edition (ISO 9981:1990), which has been technically revised. In particular, a subclause on the tolerances on the diameters over balls (3.3.4) has been added.

Annex A of this International Standard is for information only.

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Introduction

A V-ribbed belt drive a composed of an endless belt with a longitudinally ribbed traction surface which engages and grips, by friction, pulley grooves of similar shape. The belt ribbed surface fits the pulley grooves to make nearly total contact.

Belt drives — Pulleys and V-ribbed belts for the automotive industry — PK profile: Dimensions

1 Scope

This International Standard specifies the principal dimensional characteristics of V-ribbed pulley groove profiles, together with the corresponding endless V-ribbed belts of PK profile which are used predominantly for automotive accessory drive applications.

The complete array of V-ribbed belts and pulleys of PH, PJ, PK, PL and PM profile for industrial and other non-automotive applications is the subject of ISO 9982. PK belt profile dimensions and tolerances are the same in both International Standards.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of the publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

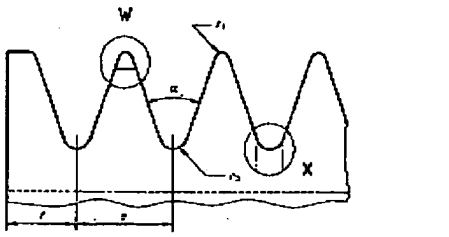
ISO 254:1998, *Belt drives — Pulleys — Quality, finish and balance.*

ISO 4287:1997, *Geometrical product specification (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters.*

3 Pulleys

3.1 Groove dimensions and tolerances

The groove dimensions of PK pulleys are shown in figures 1 and 2, and given in table 1.



W

Alternative Pulley tip profile

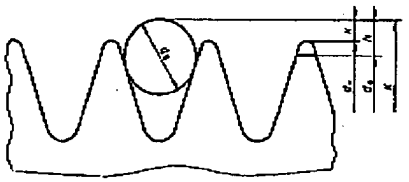
The actual configuration of the tip profile may lie anywhere between the maximum and minimum indicated. Any configuration shall have a transitional radius r_1 corresponding to a 30° minimum arc tangent to the groove sidewall

X

Alternative Pulley groove bottom

The configuration of the groove bottom below r_3 is optional

Figure 1 — Cross-section of pulley grooves



d_e = effective diameter

d_o = outer diameter

K = diameter over balls or rods

d_B = checking ball or rod diameter

Figure 2 — Pulley diameters

Table 1 — Dimensions of PK pulley grooves

Dimensions in millimetres

Groove pitch, e	$\pm 0{,}05$ [1)2)]	3,56
Groove angle, α[3)], for measuring	$\pm 0°\ 15'$	40°
Groove angle, α[3)], for testing and actual use	$\pm 1°$	40°
r_a	min.	0,25
r_b	max.	0,5
Checking ball or rod diameter, d_s	$\pm 0{,}01$	2,5
$2x$	nom.	0,99
$2N$ [4)]	max.	1,68
f	min.	2,6

1) The tolerance on e applies to the distance between the axes of two consecutive grooves.

2) The sum of all deviations from the nominal value e for all grooves in any one pulley shall not exceed $\pm 0{,}3$.

3) The centreline of the groove shall make an angle of 90° ± 0,5° with the axis of the pulley.

4) N is not related to the nominal diameter of the pulley but is measured from the actual ride position of the ball or rod in the pulley.

3.2 Minimum effective diameter

The minimum recommended effective diameter, d_e, for PK pulleys is 45 mm.

3.3 Tolerances on finished pulley

3.3.1 Checking conditions

Profile, diameter and run-out tolerances shall be checked on the finished pulley without surface coating.

3.3.2 Groove-to-groove diameter tolerances

The variation in diameters between the grooves in any one pulley shall not exceed 0,15 mm. This variation is obtained by comparing the diameters over balls or rods.

3.3.3 Radial and axial circular run-out

Radial and axial circular run-outs shall not exceed 0,25 mm full indicator movement (FIM). Run-out in the two directions is measured separately with a ball mounted under spring pressure to ensure contact with the groove as the pulley is rotated.

3.3.4 Diameter over balls

The tolerances on the diameters over balls (M) shall not exceed ± 0,8 mm.

3.3.5 Groove finish

The pulley grooves shall have a surface roughness $Ra \leq 3{,}2$ µm. See ISO 254 and ISO 4287 for definitions and the method of measurement.

3.4 Pitch diameter, d_p

The fit of a V-ribbed belt in the corresponding pulley is shown in figure 3. The true pitch diameter of a V-ribbed pulley is slightly larger than the effective diameter and its exact value is determined with the particular belt being used.

A nominal value of the effective line differential, δ_e, of 2 mm may be used to calculate the speed ratio. If more precision is required, the belt manufacturer should be consulted.

Further information is given in ISO 8370.

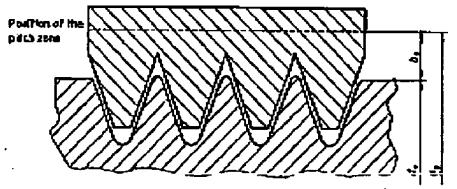


Figure 3 — Determination of pitch diameter

3.5 Designation of pulleys

A V-ribbed pulley for the automotive industry is characterized by the number of grooves, the profile and the effective diameter. It is designated by a series of numbers and letters as follows:

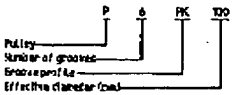
a) the first letter "P" means "Pulley";

b) the first set of numbers indicates the number of grooves;

c) the second set of letters indicates the groove profile;

d) the second set of numbers indicates the effective diameter, in millimetres.

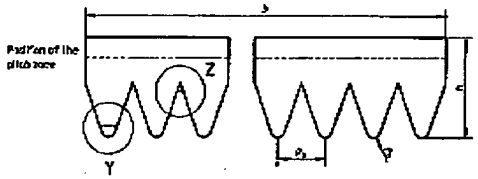
EXAMPLE



4 Belts

4.1 Belt dimensions

The dimensions of the PK belts are shown on figure 4 and given in table 2.



Nominal width of the belt $b_s = n \times p_b$, where n is the number of ribs

Alternative belt rib tip

The flat belt rib is optional

Alternative belt groove bottom

The configuration of the belt groove bottom may be anywhere between the maximum and the minimum indicated

Figure 4 — Cross-section of belt

Table 2 — PK belt dimensions

Dimensions in millimetres

Rib pitch, p_b		3,56
r_b	min.	0,5
r_t	max.	0,25
Belt height, h	≈	4 to 6

NOTE — Rib pitch and belt height are shown as reference dimensions only. Cumulative rib pitch tolerance is an important value but it is frequently affected by the tension at which the belt operates and the modulus of the tension member.

4.2 Measurement of the effective belt length

4.2.1 Measuring fixture (see figure 5)

The effective belt length shall be determined by placing the belt on a measuring fixture composed of the following elements.

4.2.1.1 Two pulleys of equal diameter, one of which is fixed and the other movable.

Their profile shall comply with figure 1 and table 1, and their recommended effective diameter shall be determined from the values given in table 3.

4.2.1.2 Device for applying a total measuring force to the movable pulley.

4.2.1.3 Device for measuring the centre distance between the two pulleys.

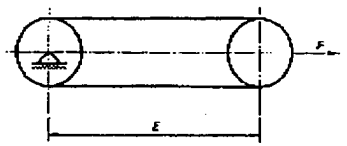


Figure 5 — Measuring fixture to determine effective length

4.2.2 Measuring force

The measuring force to be applied for measuring the effective length of belts is given in table 3.

Table 3 — Measuring pulley and measuring force

Dimensions in millimetres and measuring force in newtons

Pulley effective circumference (at level of effective diameter), U_e		300
Diameter over balls or rods, K	±0,13	96,48
Measuring force per rib, F		100

4.2.3 Procedure

To measure the effective length of a belt, rotate the belt at least two revolutions to seat it properly and to divide the total force equally between the two strands of the belt.

Then measure the centre distance between the pulleys, E, and calculate the effective length, L_e, of the belt using the following formula:

$$L_e = E_{max} + \delta_{min} + U_e$$

where

U_e is the effective circumference of the measuring pulleys;

E_{max} is the maximum centre distance between the pulleys;

E_{min} is the minimum centre distance between the pulleys.

4.3 Designation of belts

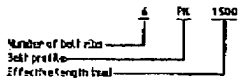
A V-ribbed belt for the automotive industry is characterized by the number of belt ribs, the profile and the effective length. It is designated by a series of numbers and letters as follows:

a) the first set of numbers indicates the number of belt ribs;

b) the letters indicate the belt profile;

c) the second set of numbers indicates the effective length, in millimetres.

EXAMPLE



Annex A
(informative)

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[1] ISO 8370-2:1993, *Belts drives — Dynamic test to determine pitch zone location — Part 2: V-ribbed belts.*

[2] ISO 9982:1998, *Belt drives — Pulleys and V-ribbed belts for industrial applications — PH, PJ, PK, PL and PM profiles: Dimensions.*

ICS 43.060.10

Descriptors: road vehicles, internal combustion engines, belt drives, pulleys, grooved pulleys, belts, power transmission belts, V-belts, dimensions, designation.

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